

Remarks

Claims 21-30 are pending upon entry of the foregoing amendments.

Amendments to the Claims

Claims 21 and 28 have been amended to clarify that the at least two flow field paths of the respective flow field plates have substantially different lengths. The Support for this amendment is found in the specification at paragraph [0037] (see Patent Application Publication No. 2004/0265675 A1). In addition, claims 21 and 28 have been amended to incorporate the limitation of claim 22. Accordingly, claim 22 has been cancelled.

Claims 21 and 28-30 have further been amended to have proper antecedent basis. No new matter has been added.

Examiner Interview

Applicants thank the Examiner for the telephonic interview on March 19, 2008, wherein the Examiner stated that she would consider the forgoing amendments.

Claim Rejections Under 35 U.S.C. § 112

Claims 21-30 were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. The rejection is respectfully traversed as applied to the amended claims.

“A claim will not be invalidated on section 112 grounds simply because the embodiments of the specification do not contain examples explicitly covering the full scope of the claim language. That is because the patent specification is written for a person of skill in the art, and such a person comes to the patent with the knowledge of what has come before. Placed in that context, it is unnecessary to spell out every detail of the invention in the specification; only

Serial No. 10/604,044
Filed June 24, 2003
AMENDMENT AND RESPONSE
TO OFFICE ACTION

enough must be included to convince a person of skill in the art that the inventor possessed the invention and to enable such a person to make and use the invention without undue experimentation.” LizardTech, Inc. v. Earth Resource Mapping, PTY, Inc. 424 F.3d 1336, 1345 (Fed. Cir. 2005) (citing Union Oil Co. v. Atl. Richfield Co., 208 F.3d 989, 997 (Fed. Cir. 2000); In re GPAC Inc., 57 F.3d 1573, 1579 (Fed. Cir. 1995)) (citations omitted).

Applicants respectfully submit that a person of ordinary skill in the art, reading the disclosure in the specification at [0039] (see Patent Application Publication No. 2004/0265675 A1) that a first molar flow rate may be proportional to a first electrochemical surface area serviced by a first flow field path, a second molar flow rate may be proportional to a second electrochemical surface area serviced by a second flow field path, each defined by equation (1), would understand that the ratio of the first molar flow rate to the second molar flow rate is equal to ratio of the first area serviced and the second area serviced when the first and second areas serviced have a current density equal to one another. The simple arithmetic manipulation required to demonstrate such a relationship can easily be performed by a skilled artisan and is demonstrated below, wherein i, s, and n are the same for the first and second flow field paths.

$$\frac{m_1}{m_2} = \frac{(i \times A_1 \times s)}{(n \times F)} \text{ is equal to } \frac{m_1}{m_2} = \frac{A_1}{A_2}$$

In addition, Applicants respectfully submit that a skilled artisan would not fail to understand that the disclosure in the specification regarding a first area a first molar flow rate being proportional to a first electrochemical surface area serviced by a first flow field path, a second molar flow rate being proportional to a second electrochemical surface area serviced by a second flow field path, each defined by equation (1) provides adequate written description for a

Serial No. 10/604,044
Filed June 24, 2003
AMENDMENT AND RESPONSE
TO OFFICE ACTION

fuel cell with a second flow field plate having third and fourth flow field paths with similar characteristics to the first flow field plate. Therefore, the rejection should be withdrawn.

Claims 21-30 were also rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. The rejection is respectfully traversed as applied to the amended claims.

M.P.E.P. § 2764.01 states that the test of enablement is whether “the experimentation needed to practice the invention undue or unreasonable”.

Applicants respectfully submit that the specification provides ample disclosure of how a person of ordinary skill in the art to make and use the fuel cells required in Applicants' amended claims. First, the specification teaches that for a given flow field path that services an electrochemical surface area, A, the formula $m = (i \times A \times s) / (n \times F)$ can be used to determine the molar flow rate of each flow path, where i = current density of the surface area serviced by the flow field path, s = fuel utilization efficiency, n = moles of electrons produced by the fuel cell per mole of the reactant consumed, and F = Faraday's constant. Thus, a skilled artisan may chose a first flow field path (e.g., flow field path **350** in **FIG. 3A** in the specification) which services a first electrochemical surface area (e.g., electrochemical surface area **356** in **FIG. 3A** in the specification) and determine the first molar flow rate using the aforementioned formula, a desired current density, a fuel utilization efficiency between 0.75 to 1, as required by amended claims 21 and 28, the moles of electrons produced by the fuel cell per mole of the reactant consumed, and Faraday's constant. Next, a second molar flow rate of a second electrochemical service area may be easily calculated, since the claims require that the ratio of the first molar

AMENDMENT AND RESPONSE
TO OFFICE ACTION

flow rate to the second molar flow rate is equal to the ratio of the first electrochemical surface area (e.g., electrochemical surface area **356** in **FIG. 3A** in the specification) to the second electrochemical surface area chosen (e.g., electrochemical surface area **346** in **FIG. 3A** in the specification).

Using this second molar flow rate, the dimensions, including the length, of the second flow field path may be determined by adjusting the geometry of the flow field channels as described in the specification. For example, at paragraph [0038] (see Patent Application Publication No. 2004/0265675 A1), the specification teaches that “[T]he length of the flow field path may be substantially proportional to a surface area of a flow field plate serviced by that flow field path . . .” and that channels forming a flow field path may be proportional in cross-sectional area to the flow plate surface area serviced by that flow field path. Thus, a person of ordinary skill in the art could easily calculate a second length of the second flow field path by multiplying the first length of the first flow field path by a ratio of the second electrochemical surface area to the first electrochemical surface area. Once the second length of the second flow field path is determined, the width and depth of channels forming the flow field path could be adjusted to provide the second molar flow rate such that there is equal current density for the first and second electrochemical surface areas. Thus, the specification completely enables a person of ordinary skill in the art to make and use the claimed fuel cells without undue or unreasonable experimentation. Therefore, the rejection should be withdrawn.

Claims 21-30 were further rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing particularly point out and distinctly claim the subject matter which applicant

Serial No. 10/604,044
Filed June 24, 2003
AMENDMENT AND RESPONSE
TO OFFICE ACTION

regards as the invention. The rejection is respectfully traversed as applied to the amended claims.

In particular, Applicants respectfully submit that the limitation that “the ratio of the first molar flow rate to the second molar flow rate is equal to the ratio of the first electrochemical surface area to the second electrochemical surface area” clearly defines the scope of the claims to a person of ordinary skill in the art. As outlined above, a skilled artisan would easily understand that this phrase specifies:

$$\frac{m_1}{m_2} = \frac{A_1}{A_2}$$

Claim Rejections Under 35 U.S.C. § 102

Claims 21-24, 26 and 28-30 were rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Patent 5,686,199 to Cavalca et al. (hereinafter “Cavalca”). Claims 21-28 and 30 were rejected under 35 U.S.C. § 102(e) as anticipated by U.S. Patent 7,067,213 to Boff et al. (hereinafter “Boff”). The rejections are respectfully traversed as applied to the amended claims.

Cavalca

Cavalca teaches that the average path length that reactant gases follows through any of the substantially symmetric flow sectors in a fuel cell is substantially the same. See Col. 8, line 64 to Col. 9, line 1. Cavalca is completely devoid of any explicit or inherent disclosure of flow field paths having different lengths at all, and certainly not substantially different lengths, as required by Applicants’ amended claims. “A claim limitation is inherent in the prior art if it is necessarily present in the prior art, not merely probably or possibly present.” Akamai Techs., Inc. v. Cable & Wireless Internet Servs., Inc., 344 F.3d 1186, 1192, 68 U.S.P.Q.2D (BNA) 1186

Serial No. 10/604,044
Filed June 24, 2003
AMENDMENT AND RESPONSE
TO OFFICE ACTION

(Fed. Cir. 2003). Merely stating that average reactant path lengths are substantially the same would not lead a skilled artisan to infer that flow field paths having different lengths at all, and certainly not substantially different lengths, are *necessarily* present in Cavalca.

In addition, Cavalca provides no disclosure or suggestion of applying the formula:

$m = (i \times A \times s) / (n \times F)$ to the design of a flow field plate.

Furthermore, Cavalca fails to disclose a first flow field path having a first molar flow rate servicing a first electrochemical surface area and a second flow field path having a second molar flow rate servicing a second electrochemical surface area, where *the ratio of the first molar flow rate to the second molar flow rate is equal to the ratio of the first electrochemical surface area to the second electrochemical surface area*. Support for this statement is found in the entire specification of Calavca, which is devoid of any disclosure or suggestion of the relationship between the molar flow rate and the electrochemical surface area of a flow field path. Moreover, M.P.E.P. § states that the burden is on the USPTO to set forth a *prima facie* case of unpatentability. As such a *prima facie* case has not been presented, Applicants' claims are novel over Calvaca.

Boff

Boff discloses a flow field having a network of progressively finer channels through which reactant gas flows. These channels collectively form flow field paths. For example, in FIG. 2, a first flow field path may be a primary gas delivery channel **4**, a secondary gas delivery channel **3**, and then a gas diffusion channel **2** and a second flow field path may be another channel **4**, another channel **3**, and then another channel **2** which does not *necessarily* result in

Serial No. 10/604,044
Filed June 24, 2003
AMENDMENT AND RESPONSE
TO OFFICE ACTION

different flow field path lengths, let alone substantially different flow field path lengths. Boff is devoid of any disclosure which would enable one of ordinary skill to determine relative lengths of two flow field paths or the molar flow rates relative to an electrochemical areas serviced by flow field paths of the reactant gases as they flow through the described channels. Thus, Boff fails to disclose flow field paths having substantially different lengths, as required by Applicants' amended claims.

In addition, Boff fails to disclose a first flow field path having a first molar flow rate servicing a first electrochemical surface area and a second flow field path having a second molar flow rate servicing a second electrochemical surface area, where *the ratio of the first molar flow rate to the second molar flow rate is equal to the ratio of the first electrochemical surface area to the second electrochemical surface area.*

Moreover, Boff provides no disclosure or suggestion of applying the formula:
 $m = (i \times A \times s) / (n \times F)$ to the design of a flow field plate. Thus, Applicant's claims are novel over Boff.

Claim Rejections Under 35 U.S.C. § 103

Claims 21-30 were rejected under 35 U.S.C. § 103(a) as obvious over U.S. Patent 6,780,536 to Debe et al. (hereinafter "Debe"). The rejection is respectfully traversed as applied to the amended claims.

The U.S. Supreme Court recently stated that "a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." KSR Int'l Co. v. Teleflex Inc., 550 U.S. ____ (2007) (Slip Op. at 14).

The Court further stated that “it will be necessary … to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an **apparent** reason to combine the known elements **in the fashion claimed…**” Id. The rejection here is based upon reasons that neither are *apparent* nor suggest modifying the elements of Debe in the *precise fashion claimed*.

Debe

Debe discloses a fluid distribution assembly having a flow field device. In one embodiment, a zig-zag flow field has a channel where the pressure drop is proportional to the path length. In addition, Debe teaches of different sizes and shapes of active areas and channels and that the channels may terminate at single or multiple openings. This general disclosure provides no apparent reason for a person of ordinary skill in the art to modify Debe *precise fashion claimed* to obtain the specific limitations of Applicants claims.

No specific apparent reason is present in Debe as to why a skilled artisan would provide 1) at least two flow field paths having substantially different lengths, or even different lengths, 2) a ratio of a first molar flow rate for a first flow field path to the second molar flow rate for a second flow field path which is equal to a ratio of a first electrochemical surface area serviced by the first flow field path to the second electrochemical surface area serviced by the second flow field path; and 3) a flow field plate utilizing the formula: $m = (i \times A \times s) / (n \times F)$ for its design, required by Applicants’ amended claims.

Thus, a *prima facie* case of obviousness has not been established.

Serial No. 10/604,044
Filed June 24, 2003
AMENDMENT AND RESPONSE
TO OFFICE ACTION

Conclusions

For the foregoing reasons, it is submitted that all of Applicants' claims are novel and non-obvious over the cited prior art. Prompt allowance of each of pending claims 21-30 is therefore respectfully solicited.

Respectfully submitted,



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